United States Patent [19]

Frohwerk et al.

[11] **4,404,879**

[45] **Sep. 20, 1983**

[54] **ACCURATELY PLACED STRESS CONCENTRATING APERTURE IN FLEXIBLE PACKAGES**

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[21] Appl. No.: **357,021**

[22] Filed: **Mar. 11, 1982**

Related U.S. Application Data

[62] Division of Ser. No. 147,018, May 6, 1980, Pat. No. 4,332,327.

[51] **Int. Cl.**[3] **B26D 1/62;** B26D 9/00

[52] **U.S. Cl.** **83/22;** 53/133; 83/18; 83/30; 83/52; 83/300; 83/345; 83/422; 83/667

[58] **Field of Search** 83/13, 18, 22, 30, 52, 83/300, 422, 345, 667, 682, 618, 620; 53/133

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Primary Examiner—Frank T. Yost

Attorney, Agent, or Firm—E. Kelly Linman; John V. Gorman; Richard C. Witte

[57] **ABSTRACT**

An "easy open" feature for a sealed flexible pouch and method and apparatus for accurately positioning said feature in the sealed border region of said flexible pouch. The feature comprises a stress concentrating aperture exhibiting a strong tendency to initiate a directional tear while maintaining integrity of the sealed pouch until an opening force is applied. In a preferred embodiment the pouches are cut from a moving web by a rotary shear cutter while a web punching means operatively connected with each cutter blade is engaged in the moving web. Because the web undergoes no movement relative to the cutting means or the punching means until both operations have been completed, the aperture is precisely positioned with respect to the severed edge of the pouch. In a particularly preferred embodiment, the sealed edge of the pouch is subjected to a high level of tension and is unsupported in the area of contact with the punching means during the aperturing operation. This concentrates the stress applied by the punching means and helps to form an aperture in the seal, even where tough and/or stretchy pouch materials which are prone to stretch and deform rather than rupture are employed. While the precise shape of the aperture is not critical, it is preferably non-circular in order to provide at least one area of stress concentration within the aperture and thereby facilitate tearing at relatively low levels of applied stress.

19 Claims, 18 Drawing Figures

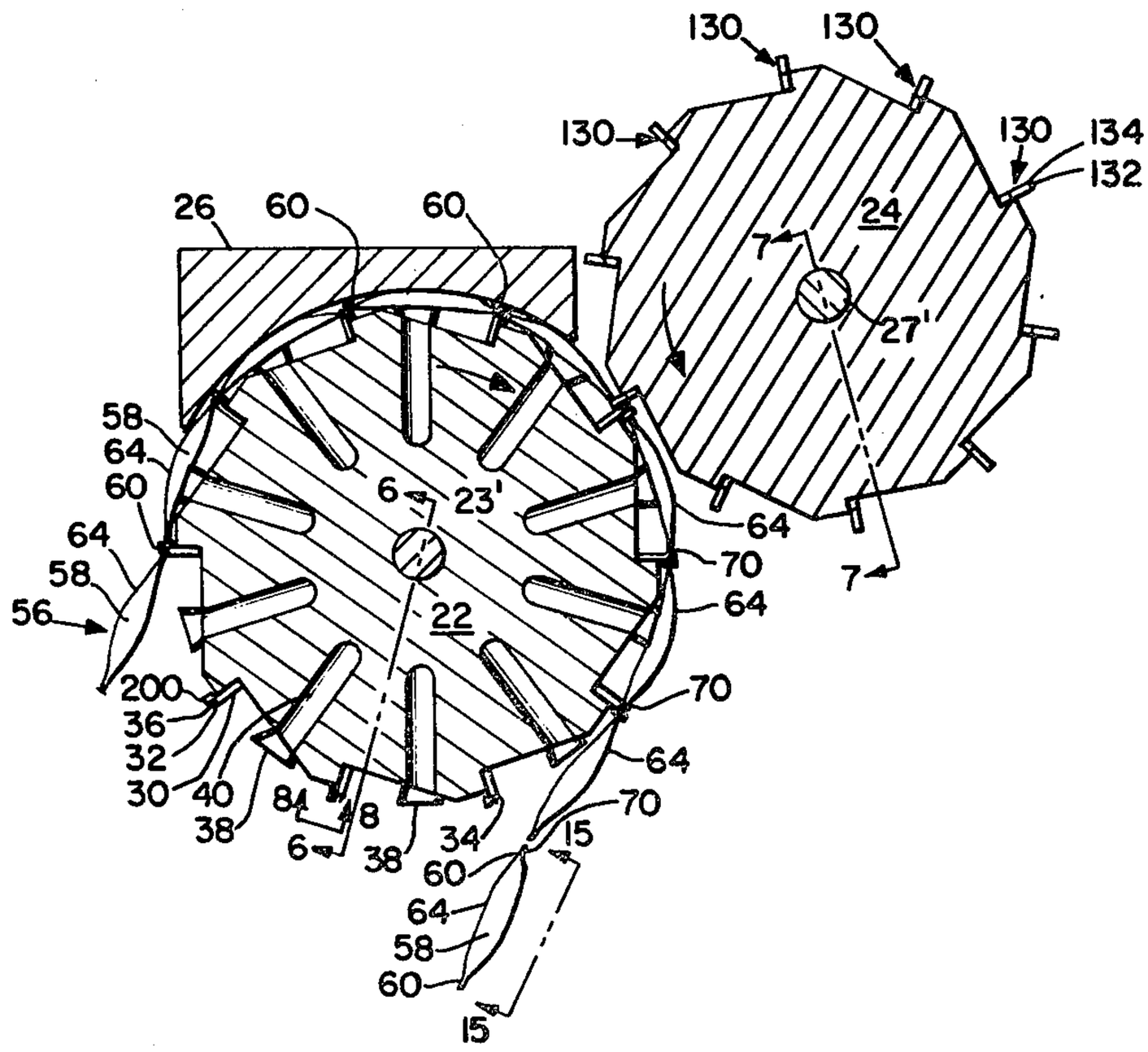


Fig. 1

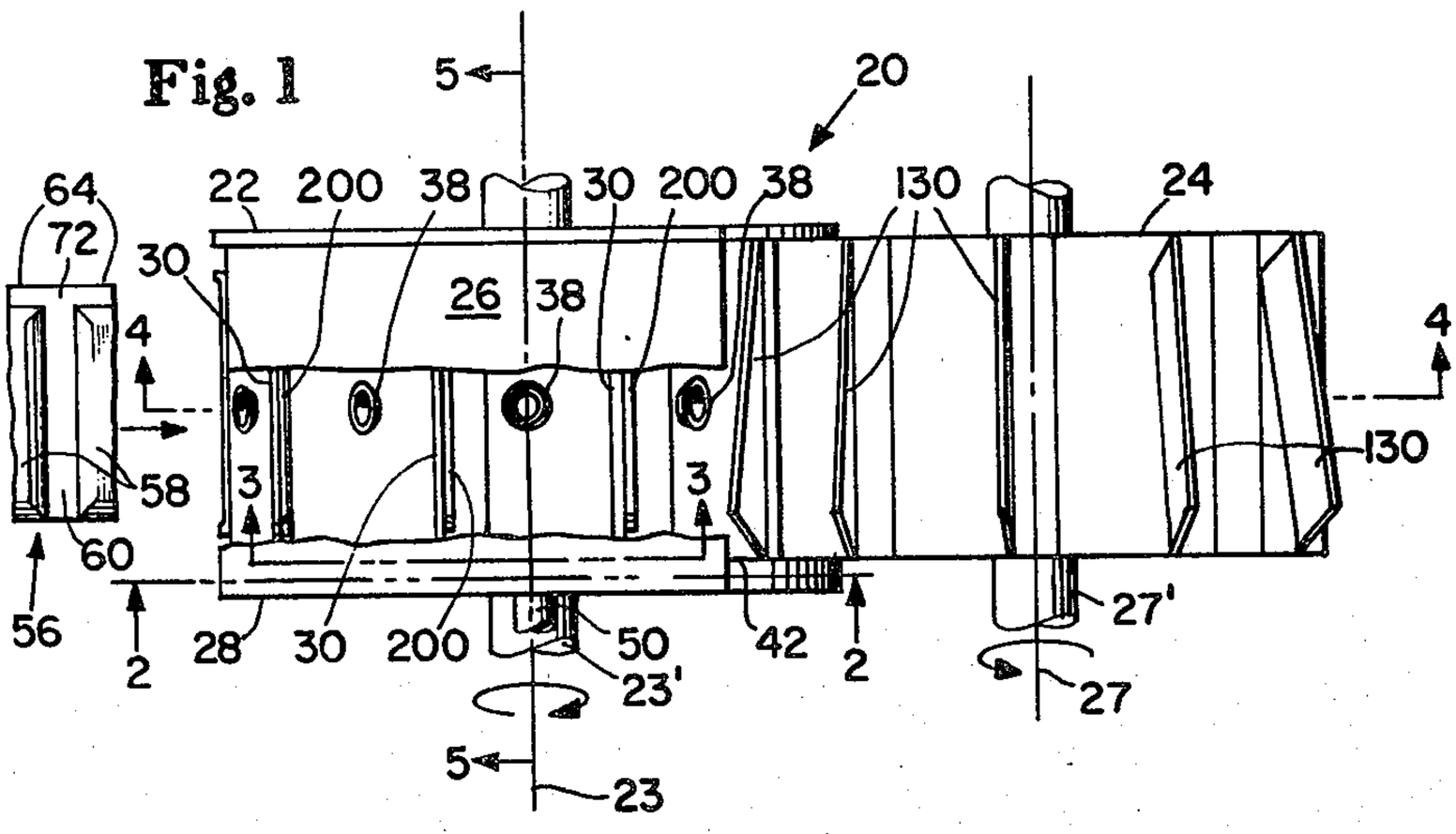


Fig. 2

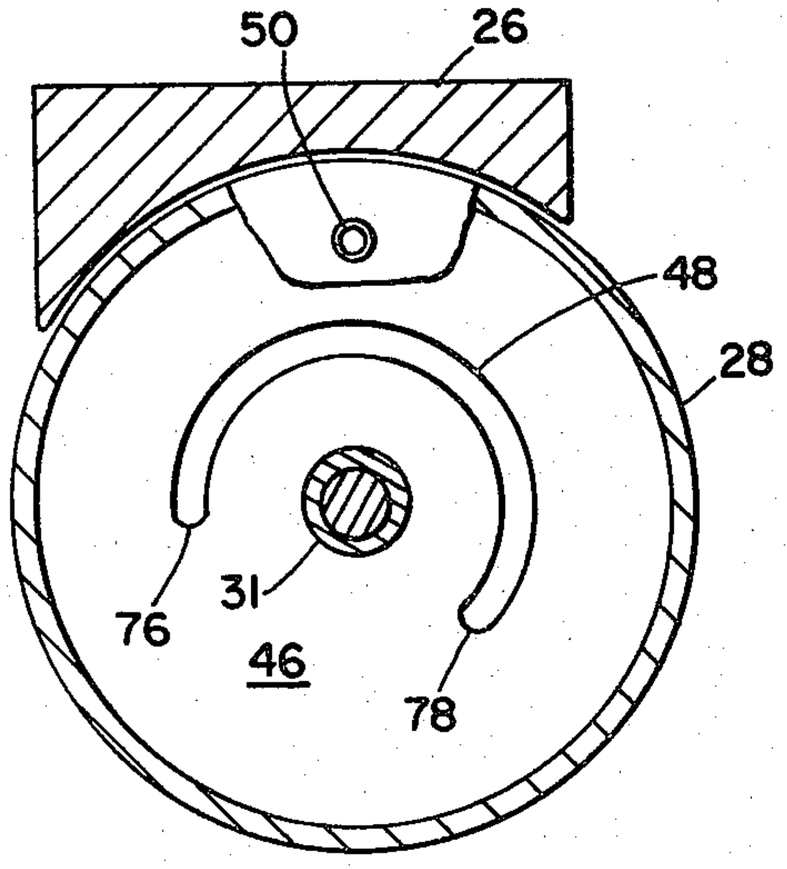


Fig. 3

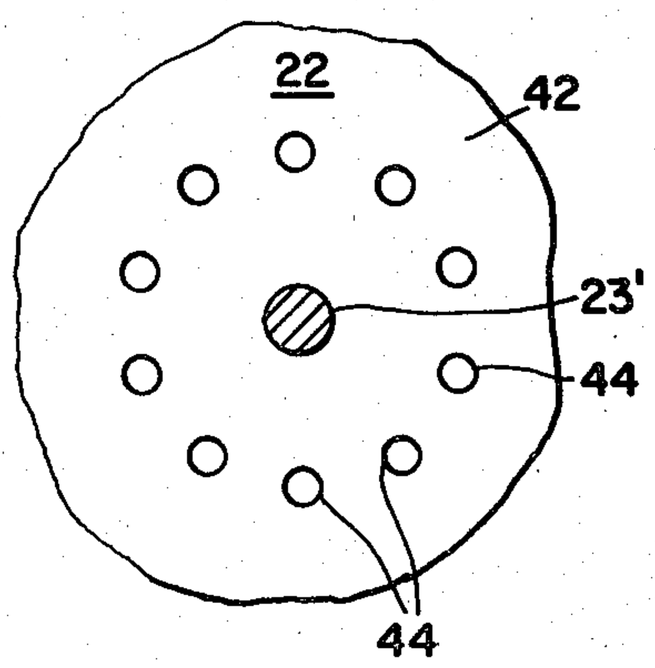


Fig. 4

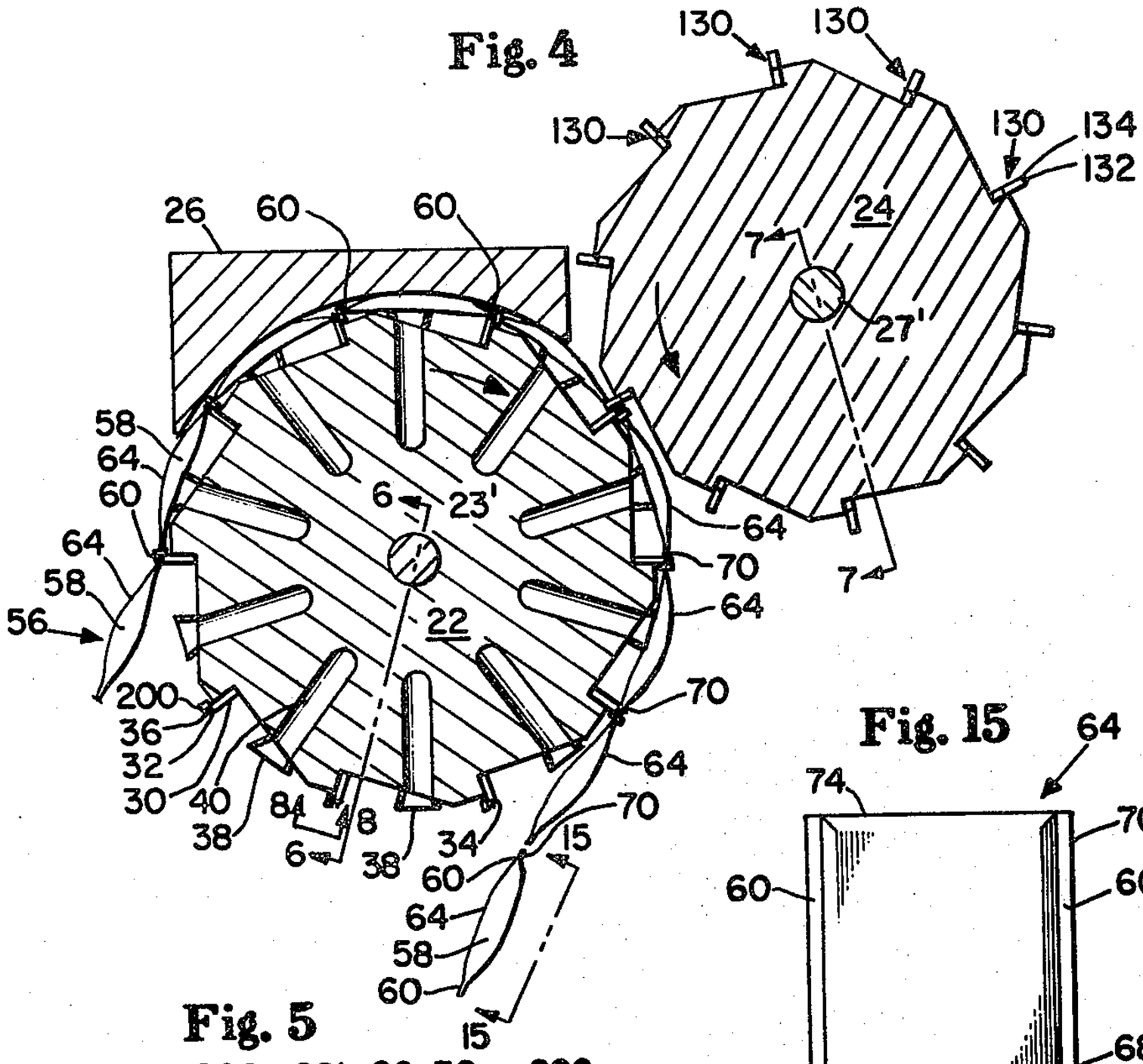


Fig. 5

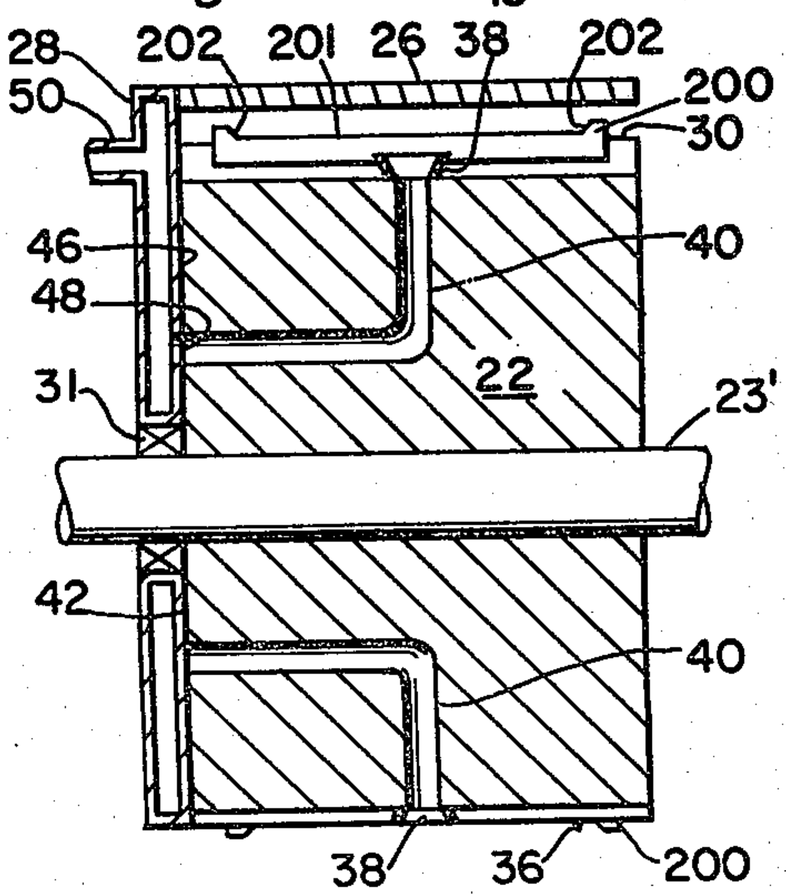


Fig. 15

Fig. 16

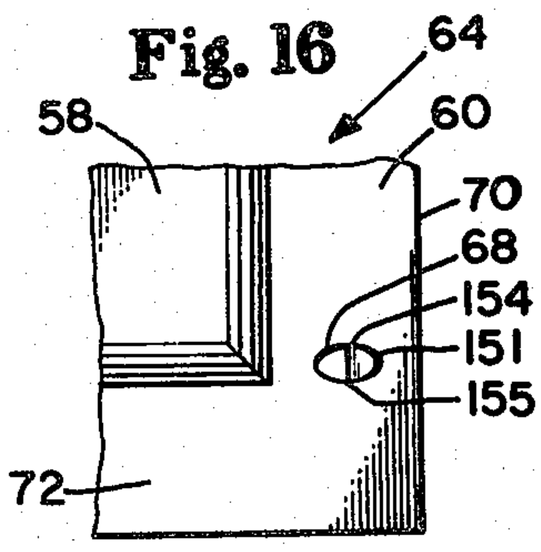


Fig. 6

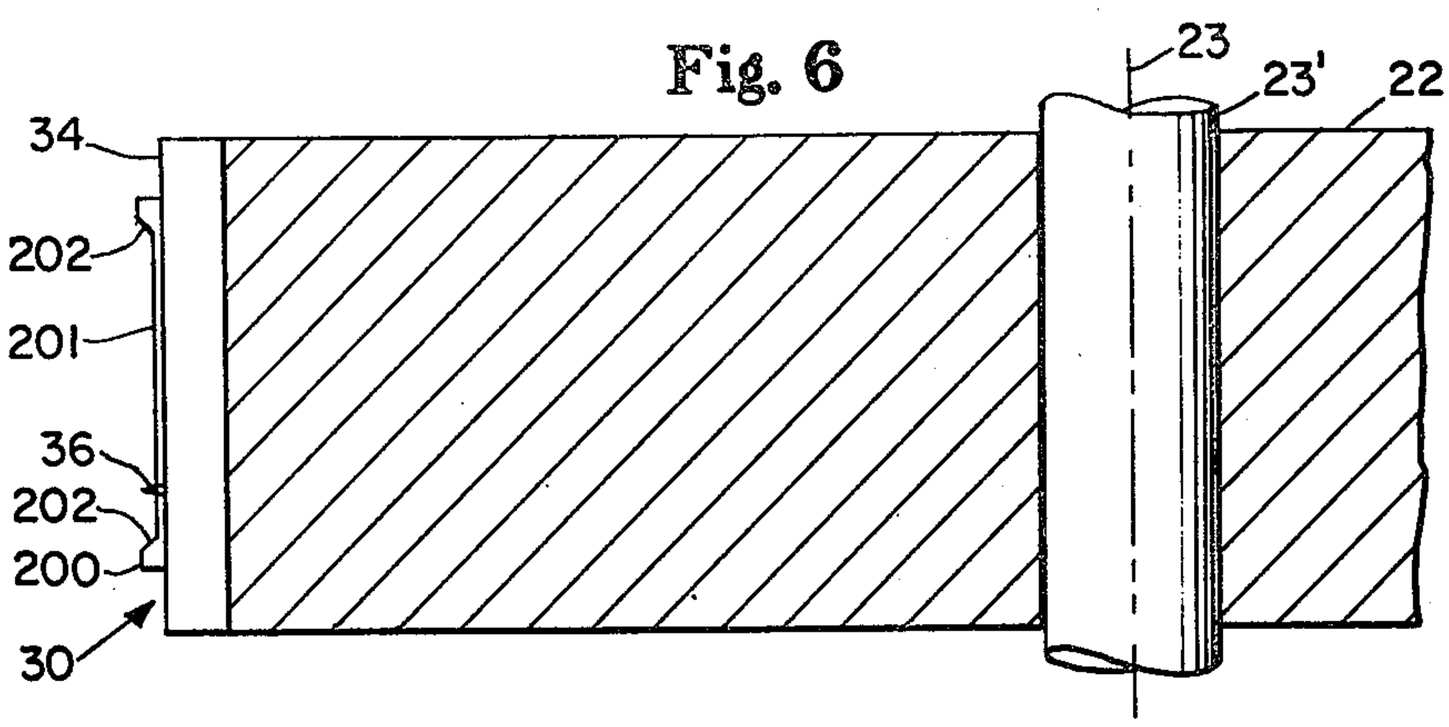


Fig. 7

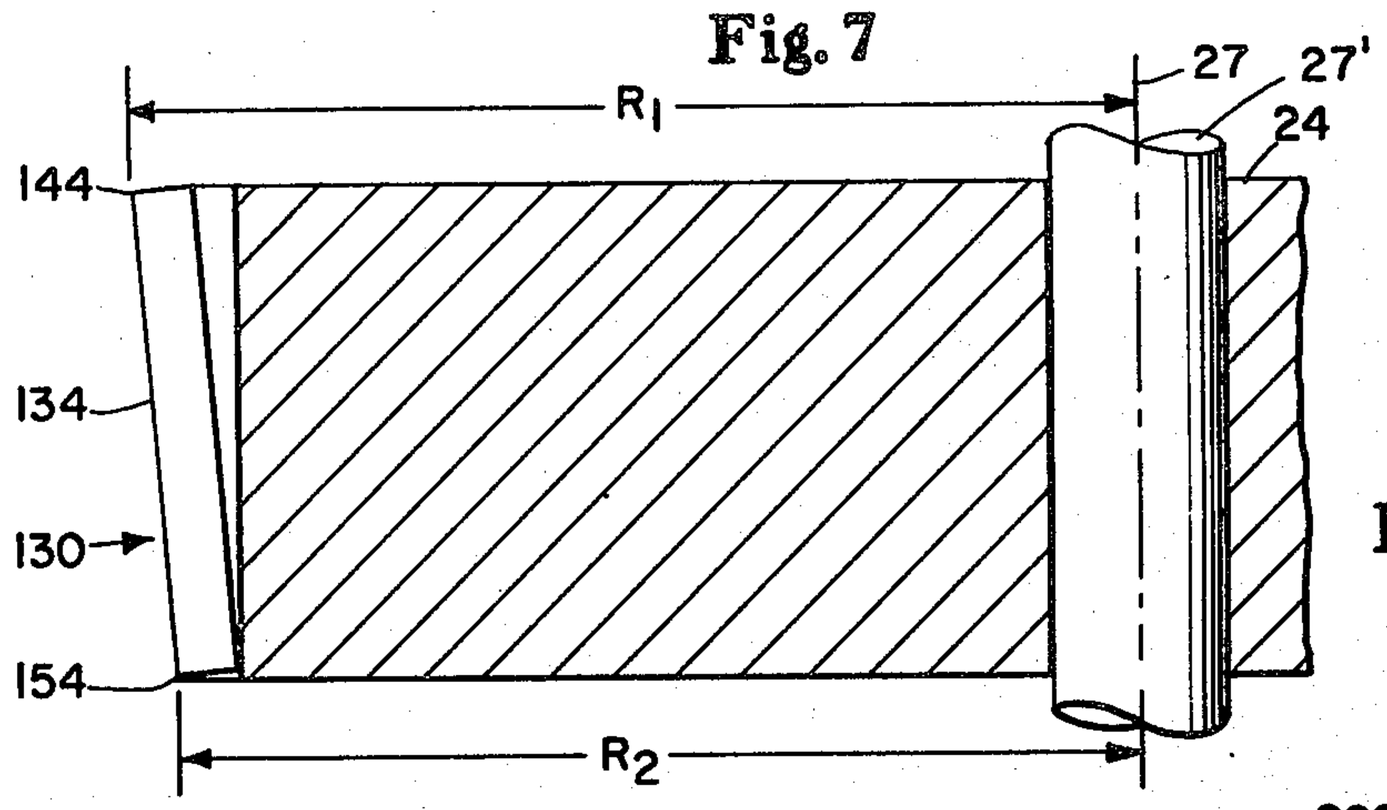


Fig. 8

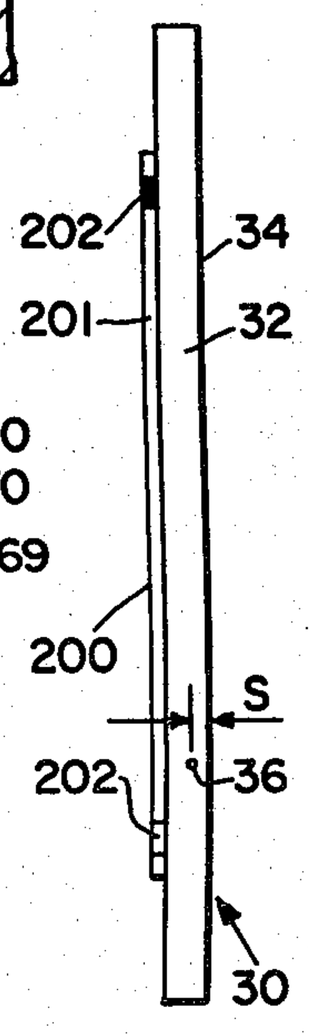


Fig. 17

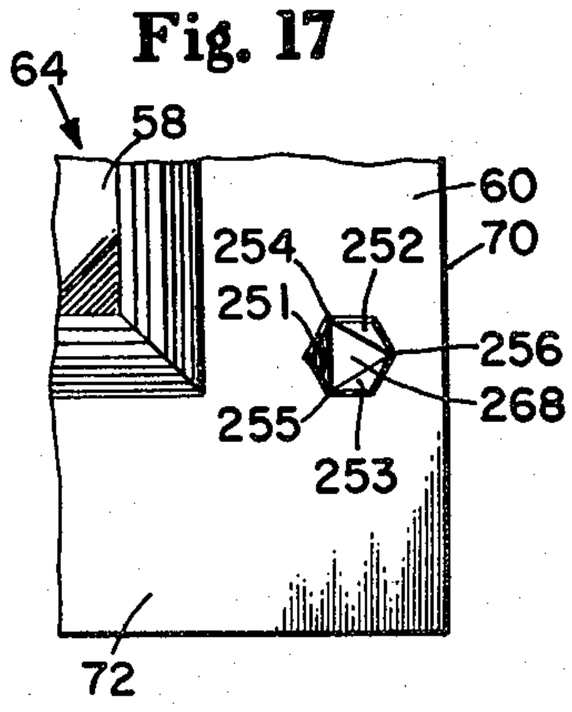


Fig. 18

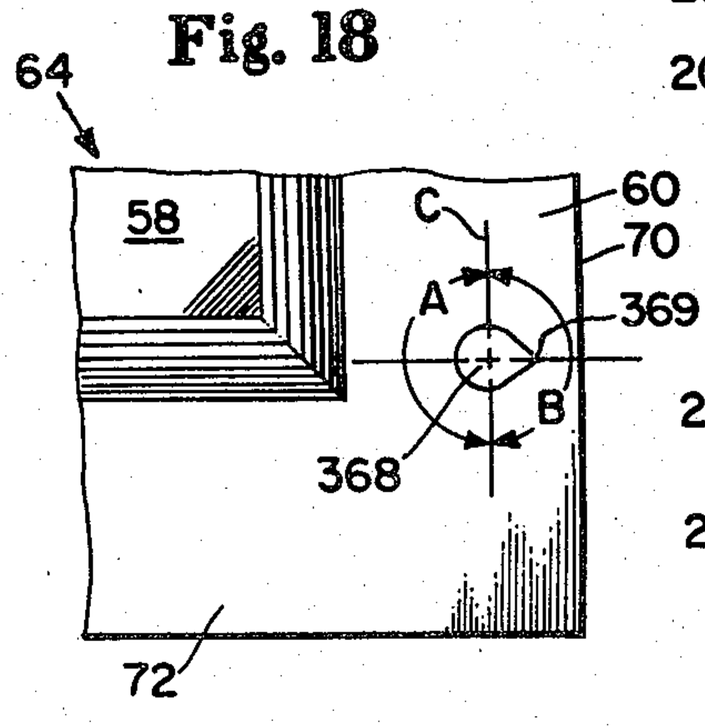


Fig. 9

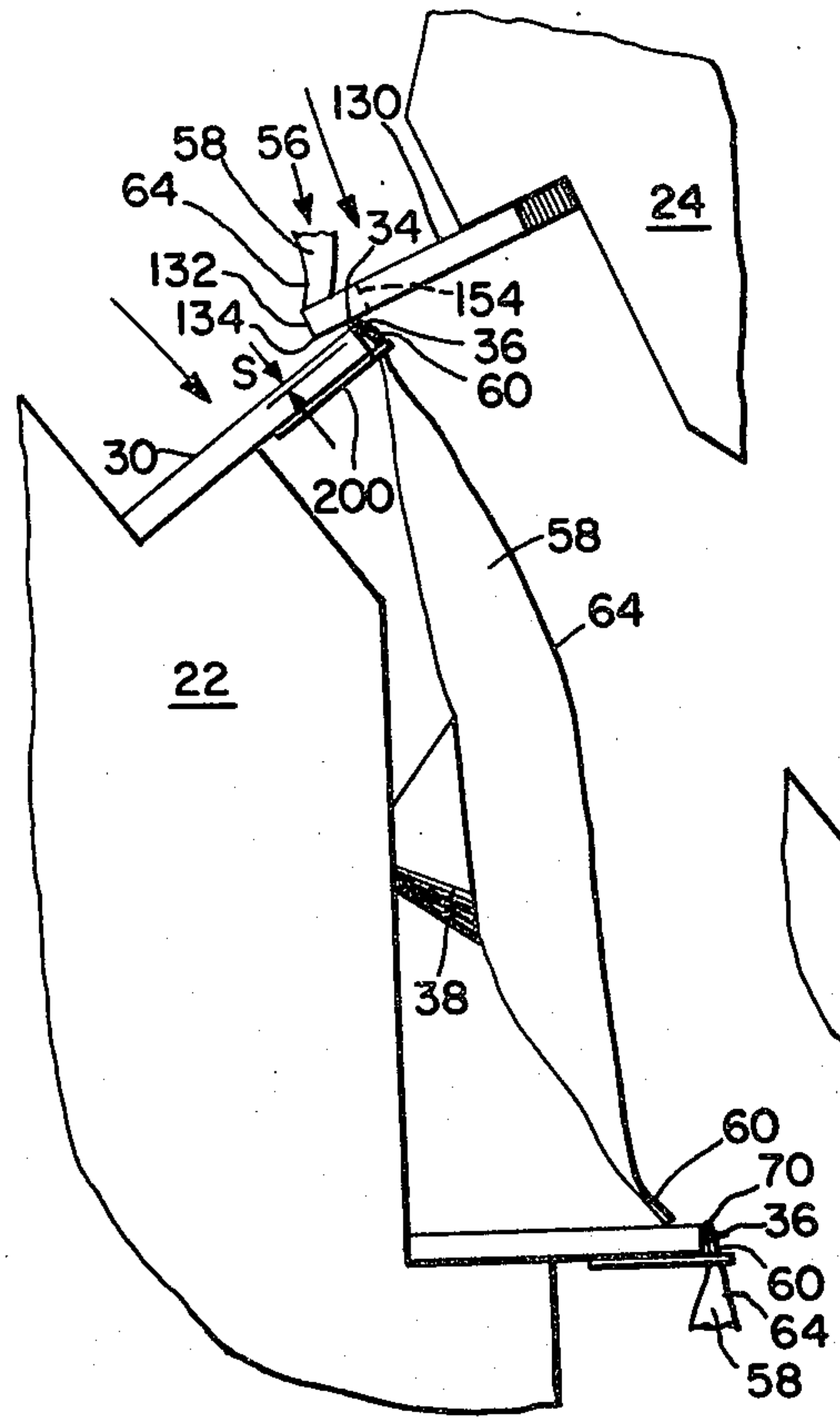


Fig. 10

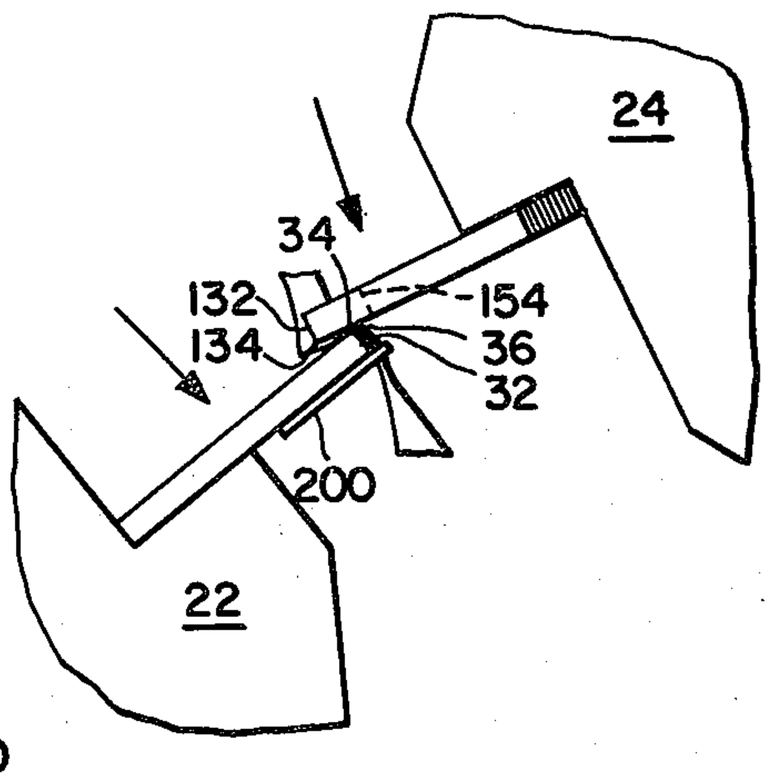


Fig. 11

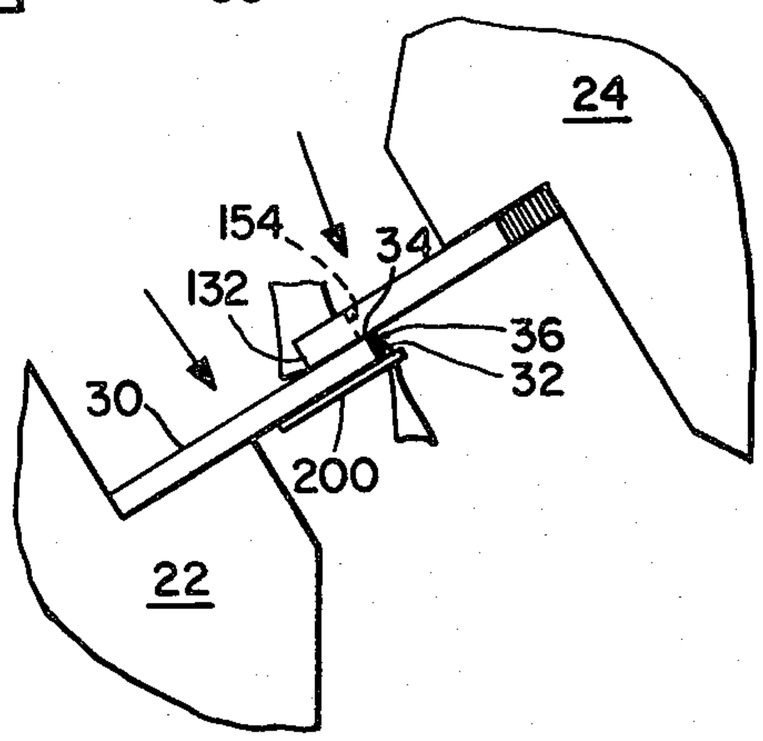


Fig. 12

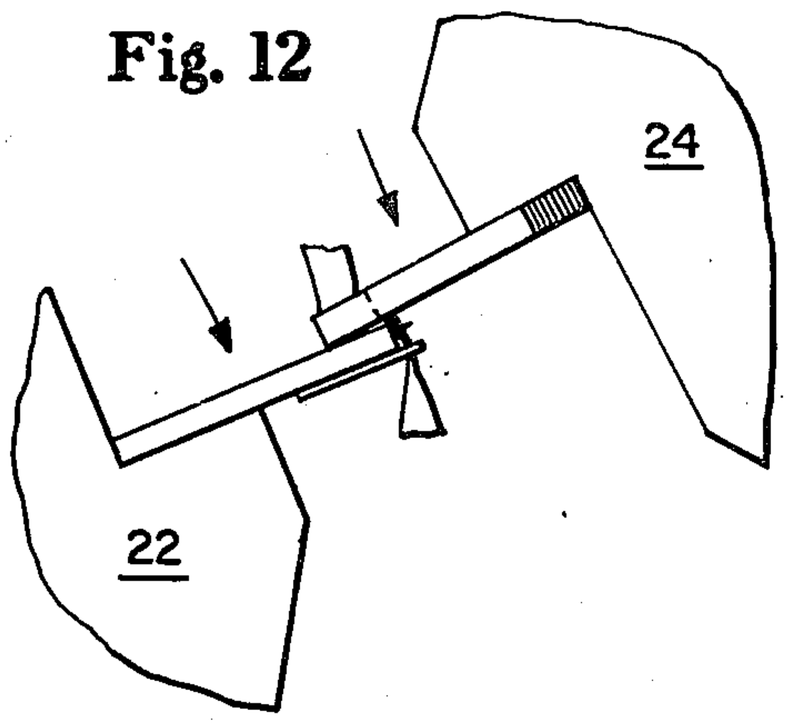


Fig. 13

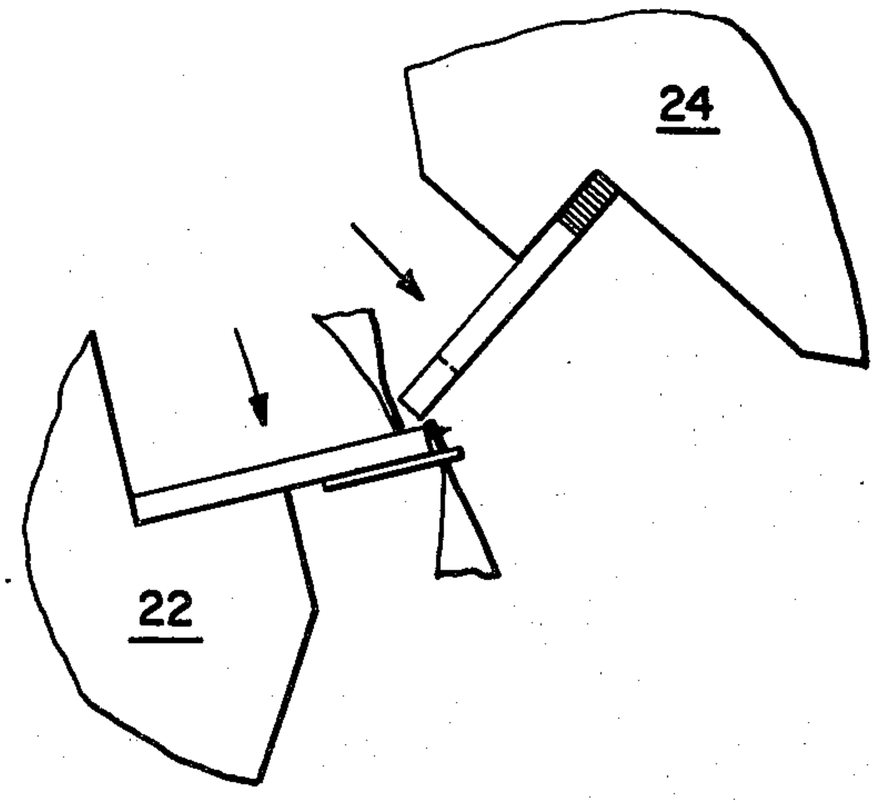
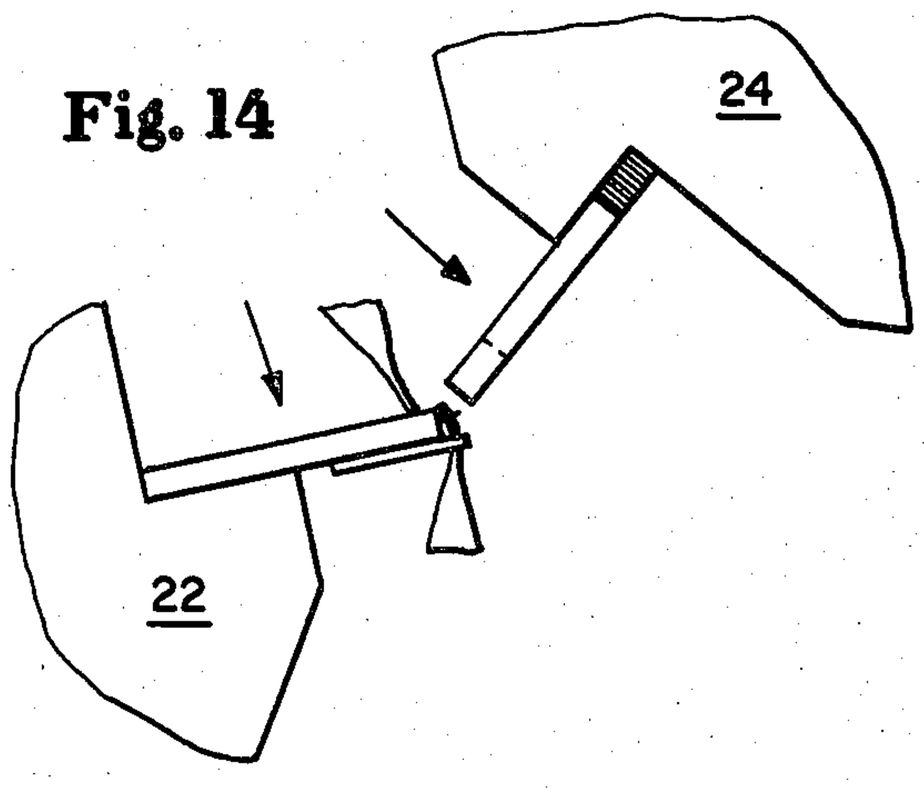


Fig. 14



ACCURATELY PLACED STRESS CONCENTRATING APERTURE IN FLEXIBLE PACKAGES

This is a division of application Ser. No. 147,018, filed May 6, 1980, now U.S. Pat. No. 4,332,327.

TECHNICAL FIELD

The present invention relates to forming "easy open" features in the seams of flexible pouches, and particularly to forming irregularly shaped "easy open" features.

BACKGROUND ART

"Easy open" features have been provided in the sealed regions of formed, filled, and sealed pouches in the past to facilitate opening of the sealed pouches. French Pat. No. 1,394,228 issued to Mauvernay on Feb. 22, 1965 is representative of such prior art practice. A line of perforations or a slit is formed in a sealed lateral seam spaced slightly below a sealed top seam that intersects perpendicularly the seam with the perforations or slit in it. A tear is initiated to open the pouch by twisting the lateral seam either across the perforations or parallel along the slit. The applied stress is thereby concentrated on the weakest area of the lateral seam, causing a tear to propagate from the perforations or slit, across the lateral seam and into the pouch in a direction generally parallel to the top seam. No method or apparatus for providing the perforations or slit is disclosed.

These prior art "easy open" features have been formed before the pouch is separated from a continuous web of filled and sealed pouches, interconnected at their lateral edges. For example, U.S. Pat. No. Re. 27,913 issued to Hutcheson on Feb. 5, 1974 discloses a process for forming a circular hole in a pouch seam using an electric eye which, when it recognizes indicia printed on the pouch, operates a reciprocating hole punching means. However, the web undergoes movement relative to the hole punching means before the transverse cut is effected downstream of the hole punching means. Accordingly, the accuracy of hole placement relative to the severed edge of the pouch with such a device is entirely dependent upon the consistency of response time of both the electric eye and the web advancing means.

U.S. Pat. No. 3,196,728 issued to Snow on July 27, 1965 discloses a machine for simultaneously punching a package support hole and an adjacent slit in a plastic package to weaken the package and thereby permit easy removal of the package when it is supported on a hook. The device disclosed in Snow operates in a manner similar to a conventional office hole punch.

It is also known in the prior art to provide cutting means for transversely cutting pouches comprised of thermoplastic film from a continuous web of interconnected pouches. Said transverse cutting is performed by means of a rotating spider employing heated metallic wires at spaced locations about its periphery while said web is secured to the periphery of a cylindrical drum on which said pouches are filled and sealed. U.S. Pat. No. 3,054,441 issued to Gex et al. on Sept. 18, 1962 describes such mechanism in detail. It is also known in the prior art to equip the transverse pouch cutting spider generally shown in FIG. 1 of the Gex et al. patent with phonograph needles mounted on radially extending arms located intermediate the heated wire cutting elements.

The phonograph needles serve to puncture the body portions of the uppermost layer of thermoplastic film to allow air trapped within the pouch during the forming operation to escape. Puncturing of the body portion of the pouch by the needle is completed after the leading edge of the pouch has been severed, but prior to severance of the trailing edge of the pouch from the web. Accordingly, the portion of the pouch being punctured is not in tension during the puncturing operation.

A film perforating means utilized in conjunction with the pouch forming and transverse cutting mechanism generally disclosed in the aforementioned patent to Gex et al. is also disclosed in U.S. Pat. No. 3,208,192 issued to Schaeffer on Sept. 28, 1965. In the Schaeffer apparatus, the perforations are provided by means of a rotating spider having pointed arms, said spider being located ahead of the transverse cutting means. The spider is driven in timed relation to the drum so as to perforate only the body portions of a first web used to form said pouches. The body perforations formed in the web which contacts the exposed periphery of the drum permit air to be evacuated from within the pouches after filling and sealing, but prior to transverse cutting.

The prior art fails, however, to disclose simple and reliable web cutting means having punching means operatively connected therewith for continuously forming precisely registered "easy open" apertures in the sealed region of a pouch while the pouch is being severed from a continuously moving web. Furthermore, the prior art fails to disclose such means wherein said web is held stationary relative to said transverse cutting and said aperture punching means until both operations have been completed.

As will be appreciated by those skilled in the art, it is highly desirable that the stress concentrating aperture be accurately positioned with respect to the edge of the pouch. If the aperture is positioned too close to the pouch edge, it will be too easy to open the pouch, thereby increasing the likelihood that the pouch will be accidentally opened when handled or in transit. On the other hand, if the aperture is positioned too far from the pouch edge it may be difficult for the user to initiate a tear to open the bag, or even worse, the product-containing portion of the pouch may be penetrated. This is particularly undesirable where the product contained within the pouch is subject to degradation upon exposure to the atmosphere.

It is also desirable that the aperture have at least one internal area of stress concentration to facilitate initiating a tear when relatively low stress levels are applied thereto.

Accordingly, it is an object of the present invention to provide a flexible pouch having a stress concentration aperture precisely located in one of its seal areas, said aperture exhibiting a strong tendency to initiate a tear in the direction of the severed edge of the pouch rather than toward the pouch body when relatively low stress levels are applied thereto. It is another object of the present invention to provide simple and reliable method and apparatus for continuously forming precisely located stress concentration apertures in the sealed areas of pouches as they are severed from a continuous web of interconnected pouches. It is also an object of the present invention to ensure that the aperture is precisely positioned with respect to the edge of each pouch in automatic fashion, regardless of variations in web speed. It is still another object to provide a continuous process for forming precisely located stress

concentration apertures wherein the means for providing said apertures are operatively connected with the means employed to sever said pouches from said web, said web being held stationary relative to said cutting and said aperturing means until both operations have been completed. It is yet another object of the present invention to provide such method and apparatus which will function reliably, even where tough and/or stretchy pouch materials are employed.

DISCLOSURE OF INVENTION

Disclosed herein is a novel "easy open" stress concentrating feature comprising an irregularly-shaped aperture located in the seal area of a flexible pouch. Also disclosed herein are novel process and apparatus for forming a precisely registered, "easy open" stress concentrating aperture adjacent a lateral edge of each filled and sealed pouch severed from a continuous web of pouches interconnected to one another along their lateral edges. The process preferably includes the step of operating a pouch cutting means operatively connected to a punching means to punch an aperture in the sealed lateral edges of the filled and sealed pouches as the adjacent lateral edge of each of said pouches is cut from the continuous web, said web being held stationary relative to said cutting means and said punching means until both operations have been completed. The aperture formed in the pouch is precisely located with respect to the lateral edge formed by the pouch cutting means to facilitate consistent easy opening of the pouch. Furthermore, the aperture is preferably shaped to provide at least one internally-located area of stress concentration. Unlike the circular perforation taught by the prior art, the area of stress concentration provided within an aperture of the present invention tends to facilitate tearing the area between said aperture and the adjacent severed edge of the pouch at relatively low applied force levels. Once the edge of the pouch has been broken by the tear, the remainder of the pouch is easily opened by manually separating the pouch segments on opposite sides of the tear from one another.

Also disclosed is a preferred embodiment of a machine for forming pouches with such precisely registered "easy open"apertures from a continuous web of pouches interconnected to one another at their lateral edges. The machine includes a pouch cutter for making transverse cuts across the moving web to separate the pouches from the web. It further includes at least one cutting blade having an aperturing punch operatively connected to it. The punch is so spaced from the edge of the pouch cutting blade that it will form a stress concentrating aperture spaced the desired distance from the adjacent transverse cut. The unsupported web is contacted by the punch while in tension to ensure that the punch bursts through the web. In a particularly preferred embodiment, the punch forms an aperture having at least one internally located area of stress concentration.

BRIEF DESCRIPTION OF THE DRAWINGS

While the specification concludes with claims particularly pointing out and distinctly claiming the present invention, it is believed the present invention will be better understood from the following description in conjunction with the accompanying drawings in which:

FIG. **1** is a simplified plan view of a preferred apparatus of the present invention with the web of interconnected pouches normally processed thereon partially broken away for clarity;

FIG. **2** is a cross-sectional view taken along section line **2—2** of FIG. **1**, with the vacuum source connection to the commutator shown in fragmentary fashion for added clarity;

FIG. **3** is a fragmentary cross-sectional view taken along section line **3—3** of FIG. **1**;

FIG. **4** is a cross-sectional view taken along section line **4—4** of FIG. **1**, showing a web of interconnected pouches being processed in accordance with the present invention;

FIG. **5** is a cross-sectional view taken along section line **5—5** of FIG. **1**;

FIG. **6** is a simplified view taken along section line **6—6** of FIG. **4**;

FIG. **7** is a simplified view taken along section line **7—7** of FIG. **4**;

FIG. **8** is an enlarged view taken along view line **8—8** of FIG. **4**;

FIGS. **9–14** are enlarged fragmentary views of the cutting apparatus shown in FIG. **4**, showing a complete pouch cutting and punching cycle;

FIG. **15** is an enlarged view, taken along view line **15—15** of FIG. **4**, of a discrete pouch processed in accordance with the present invention to provide an "easy open" aperture of the present invention in one of its lateral seals;

FIG. **16** is an enlarged view of the stress concentrating aperture portion of the pouch shown in FIG. **15**;

FIG. **17** is a view generally similar to FIG. **16**, but showing an alternatively shaped stress concentrating aperture of the present invention; and

FIG. **18** is a view generally similar to FIG. **16**, but showing a schematic representation of a stress concentrating aperture of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Referring to the drawings wherein like reference characters are utilized for like parts throughout the several views, there is shown in FIG. **1** a rotary shear cutter **20**. The cutter **20** includes a driven forwarding roll **22** and a driven mating roll **24** which rotate about parallel axes **23**, **27** on shafts **23'**, **27'**, respectively, in opposite directions with respect to one another. In the embodiment shown in FIGS. **1** and **4**, forwarding roll **22** rotates in a clockwise direction, while mating roll **24** rotates in a counterclockwise direction. A saddle-shaped guide **26** straddles forwarding roll **22** and serves to position a web **56** of interconnected pouches **64** to be cut on forwarding roll **22**. The web **56**, which is fed onto forwarding roll **22** under tension, has, in FIG. **1**, been partially broken away for clarity. The cutter **20** also includes a vacuum commutator **28** which abuts an end of forwarding roll **22**.

As is clearly shown in FIG. **4**, each of the rolls **22**, **24** has mounted about its periphery equally spaced, radially aligned cutting blades **30**, **130**, respectively. The blades **30**, **130**, which are preferably fabricated so as to be identical to one another, extend across the axial length of the rolls **22** and **24**. As can be more clearly seen from FIGS. **6** and **7**, cutting blades **30** are mounted on forwarding roll **22** with their cutting corners **34** in parallel alignment with the axis **23** of roll **22**, while cutting corners **134** of cutting blades **130** are nonparallel to the axis **27** of mating roll **24**. As shown in FIG. **7**, the angular alignment of cutting blades **130** with respect to

axis **27** of roll **24** procudes a maximum effective radius R_1 at the uppermost end **144** of blade **130** and a minimum effective radius R_2 at the lowermost end **154** of blade **130**. The angular alignment of cutting blades **130** has been exaggerated for clarity. Furthermore, it will be appreciated by those skilled in the art that shaft **27'** on which mating roll **24** is mounted is resiliently supported to allow at least a degree of deflection to occur as said shearing operation takes place. This ensures point contact between cutting corners **34** and **134** without causing damage to blades **30** and **130**.

As can be seen in FIG. **4**, the angular spacing arrangement of blades **30** and **130** around the periphery of rolls **22** and **24** is identical. Accordingly, the two rolls are adjusted in their position with respect to one another so that when they counterrotate a cutting corner **34** of each blade **30** on roll **22** will come into shearing abutment with a corresponding cutting corner **134** of a mating blade **130** on roll **24**. FIGS. **9–14**, which disclose a complete cutting and punching cycle for one pouch, clearing disclose that the distance between the axes **23** and **27** of rolls **22** and **24** is such that the cutting blades **30** and **130** on the two rotating rolls intermesh sufficiently to produce a scissors-like cutting action completely across the web **56** of interconnected pouches **64**.

As can be seen in FIGS. **6** and **8**, each of the blades **30** on forwarding roll **22** has secured to its exposed peripheral surface **32** at least one pin **36** which extends radially outward beyond peripheral surface **32** of the blade. As can be seen from FIGS. **8** and **9**, it is the pin's spacing "S" from cutting corner **34** of each blade **30** which controls the position of the stress concentrating aperture **68** in the finished pouch **64** relative to the severed edge **70** of the pouch. As is also apparent from FIGS. **6**, **8** and **9–14**, each blade **30** on forwarding roll **22** is provided with a web support member **200** which, in a preferred embodiment, is adjustably secured thereto by means well known in the art. Each web support member **200** is provided with a recessed land area **201** having an overall length substantially equal to the width of web **56**. The tapered sections **202** of web support member **200** serve to align the web **56** with land areas **201**, thereby ensuring that the stress concentration aperture **68** is spaced the desired distance from the top seal **72** of each pouch **64** cut from the web. As can be seen from FIGS. **9–14**, the maximum height of pin **36** above the peripheral surface **32** of blade **30** must not be so great that any portion of mating blade **130** on mating roll **24** will interfere with the pin **36** as it rotates past. This is more clearly illustrated in FIG. **9**, wherein the criticality of the angular mounting of blade **130** relative to axis **27** can be clearly discerned. The shear cutting action imposed on web **56** along transverse seal **60** is also due to the angular inclination of blades **130** to axis **27**, since it is the result of cutting corner **134** of blade **130** riding across cutting corner **34** of blade **30**, as generally shown in FIGS. **9–14**.

When used on hand-sized film pouches, pin **36** may conveniently be a piece of music wire made of hardened spring steel, and having a diameter from about 0.15 millimeters to about 2 millimeters. The pin is preferably recessed into the blade **30** to a depth between about 0.5 and about 1.5 centimeters. It is preferably secured in blade **30** by means of a set screw (not shown) which threads into the blade transverse to the length of the pin and butts against the pin at an intermediate point along its length.

Since the properties of different types of film vary greatly, and since different films may be employed to provide the characteristics desired in the finished pouch, the pin size, sharpness and configuration are preferably optimized by preliminary testing on sample pouches to determine their resistance to puncture. Furthermore, since the spacing between the edge of the stress concentration aperture and the severed edge of the pouch can be precisely controlled in the practice of the present invention, the amount of force required to initiate pouch opening can be designed into the finished pouch by proper selection of aperture shape, size and position relative to the severed edge. The exposed pin tip may, for example, be relatively sharp and tapered. It may also be conical, beveled, or irregularly shaped to provide the desired aperture configuration in the web **56**. If desired, the pin cross-section can also exhibit the preferred shape along its entire length to accommodate pin wear without appreciably changing the shape of the stress concentrating aperture **68** produced in the web. A non-round pin cross-section may also be used to consistently orient a non-cylindrical pin relative to blade **30**.

As can be seen from FIGS. **9–14**, a stress concentration aperture **68** in the web **56** and the adjacent transverse cut across the web are made essentially simultaneously, web **56** being held stationary relative to both the cutting means and the punching means until both operations have been completed. Thus, there is no loss of registration between the severed edge **70** of pouch **64** and the adjacent stress concentration aperture **68** where, as in the illustrated embodiment, the cutting and pouching means are operatively connected with one another.

In the illustrated embodiment, the transverse cut is made while the implement used to form the adjacent stress concentration aperture is engaged in the web. As shown in FIGS. **9–14**, pin **36** is caused to penetrate the web **56** as blades **30** and **130** perform the adjacent transverse cutting operation in shear-like fashion along corners **34** and **134**. Web support members **200** serve to elevate the web **56** across the peripheral surface **32** of blade **30**. The web support members **200**, which contact web **56** along their land areas **201**, are radially adjustable either inwardly or outwardly by means well known in the art to accommodate pouches of varying capacities and to vary the amount of tension applied to that portion of web **56** intermediate cutting corner **34** of blade **30** and the web support member.

The pouch **64** being severed from web **56** is secured to forwarding roll **22** by means of a suction gripper **38** during the aperturing operation. In addition the product within pocket **58** of the pouch being severed resists the pouch's being drawn across the leading edge of web guide **200** during the aperturing operation. Accordingly, the shearing action provided as blades **30** and **130** abut one another along their cutting corners **34** and **134** causes that portion of web **56** intermediate support member **200** and cutting corner **34** to be drawn while in an unsupported condition into contact with the exposed tip of pin **36**, thereby causing relatively high tension and extremely high stress concentration at the point of pin contact. This results in bursting of the seal area **60** of the web **56** by pin **36** and formation of a stress concentrating aperture **68** therein.

In many situations, the pouch is comprised of a relatively tough and/or stretchy material which is highly resistant to rupture. In addition, the bonded seal areas to be apertured are of double thickness. Thus it is the

localized tension applied during transverse cutting by blades **30** and **130** and the resulting stress concentration at the tip of pin **36** which helps the pin burst the seal area to form aperture **68**. It should be noted that where tough and/or stretchy pouch materials are employed, the distance over which the localized tension is applied, i.e., the distance as measured along web **56** between cutting corner **34** and web guide **200**, is preferably minimized to avoid large scale web deformation by pin **36** without rupture thereof.

As will be appreciated from FIG. **9**, that portion of web **56** containing stress concentration aperture **68** forms the hypotenuse of a triangle having a base comprising peripheral surface **32** of blade **30** and an altitude comprising that portion of web support member **200** between land area **201** and the peripheral surface **32** of blade **30**. Because the stress concentration aperture **68** is formed while the web is at an angle to pin **36**, the stress concentration aperture **68** will not, in most instances, be identical to the cross-section of the pin tip. If an aperture having a shape substantially the same as that of the cross-section of the pin tip is desired, the pin tip may be bent or mounted at an angle with respect to blades **30** so as to intersect web **56** essentially perpendicularly at the point of contact. Accordingly,, the novel process and apparatus disclosed herein may be used with equal facility to form either novel stress concentrating apertures of the present invention or conventional prior art stress concentrating apertures such as circular perforations or slits.

As will also be appreciated, the precise location of the aperture **68** relative to the cut edge **70** of pouch **64** corresponds to the distance between cutting corner **34** of blade **30** and the adjacent edge of pin **36**, as measured along the hypotenuse of the triangle described earlier herein.

FIG. **11** represents the condition existing after the shear cut of web **56** has been completed and lowermost edge **154** of cutting blade **130** projects below cutting corner **34** of blade **30**. FIGS. **12** and **13** represent the condition prevailing relative to a pair of mating blades **30** and **130** after the transverse cut of web **56** has been completed and the discrete pouch **64** proceeds forward secured to roll **22**.

Forwarding roll **22** preferably includes a series of frusto-conical vacuum grippers **38** situated mid-way between each pair of adjacent blades **30** on the periphery of roll **22**. The functioning of grippers **38**, shown in FIG. **4** in cross-section, is controlled by vacuum commutator **28**. Each of the grippers **38** communicates with end wall **42** of roll **22** adjacent the vacuum commutator **28** by means of L-shaped ducts **40** which extend radially into the roll from the respective grippers **38** and axially along the roll to end wall **42** as shown in FIG. **5**. Circular openings **44**, shown in FIG. **3**, created in end wall **42** by the emergence of L-shaped ducts **40** from roll **22** communicate with commutator **28**.

The commutator **28** is preferably a hollow cylindrically-shaped chamber whose axis is colinear with that of roll **22**, but which is mechanically isolated, conveniently by means of bearing **31**, from shaft **23'** which passes through its center. Rotation of commutator **28** is prevented by attachment (not shown) to guide **26** which is fixed. An arcuate U-shaped slot **48**, shown in FIG. **2**, is cut in the commutator's forward face **46** which abuts end wall **42** of forwarding roll **22**. The diameter of the arc defined by slot **48** is identical to the diameter of the arc containing openings **44**. The U-shaped slot **48**, whose width in the radial direction equals the diameter of the openings **44** in end wall **42**, extends through an arc sufficient to achieve the desired cycle of vacuum application, as explained hereinafter. A vacuum line **50** which connects to a vacuum source (not shown) maintains a vacuum in the interior portions of the commutator **28**. The commutator **28**, which is stationary, fits snugly against the moving end wall **42** of the roll **22**. In order to decrease the friction between end wall **42** of roll **22** and the exposed face **46** of commutator **28** either or both of their abutting surfaces may be made from a low friction material such as Teflon or the like.

When the openings **44** in end wall **42** initially come into communication with the U-shaped slot **48** shown in FIG. **2**, suction is applied via L-shaped ducts **40** to the suction grippers **38** connected to said openings. Conversely, when openings **44** are occluded by the exposed face **46** of commutator **28** at the end of U-shaped slot **48** no vacuum is applied to grippers **38**, and the previously established vacuum is quickly lost so that no suction is present at the affected grippers.

The saddle-shaped guide **26**, which is mounted on a fixed support (not shown), serves to guide the tensioned incoming web to be cut over roll **22** and down into the nip between forwarding roll **22** and mating roll **24**. The guide **26**, in conjunction with web support members **200** secured to blades **30**, adjusts the radial position of the web to be cut with respect to roll **22**. The guide **26** is concave to conform to the shape of the roll **22**, but is spaced sufficiently therefrom to just allow the web **56** to pass therebetween. The pressure applied by guide **26** against the web **56** causes the web to be pressed against the blades **30** and the vacuum grippers **38**. In this way the web **56** is held tightly between adjacent blades **30**, and jamming of the web in the nip between rolls **22** and **24** is prevented. Preferably, the pressure supplied by guide **26** and the tension present in web **56** is sufficient to initiate deformation, if not impaling, of the moving web **56** on pins **36**. This further aids in maintaining the spacing between adjacent pouches **64**.

In operation the web processing system of the present invention preferably works as follows. A planar sheet of web stock is folded upon itself, preferably about its centerline, and pockets **58** defined intermediate transverse seals **60** are continuously formed at spaced locations along its length. The moving web **56** is then filled, and a top seal **72** is applied continuously along the length of the web to provide sealed interconnected pouches **64**. The completed web of interconnected pouches **64** is continuously forwarded into rotary shear cutter **20**. The moving web **56** is passed while under tension between guide **26** and forwarding roll **22**, which is indexed to position a pouch **64** over a vacuum gripper **38**, while the sealed lateral portions **60** between each filled pouch **64** are centered over the cutting corner **34** of a blade **30**, as shown in FIG. **4**.

The web **56** is pressed by guide **26** against the rotating forwarding roll **22**, preferably initiating deformation, if not impalement, of the sealed lateral portion **60** by the upstanding pin **36** in each blade **30**. The tension present in web **56** and the direction provided by guide member **26** and web support members **200** secured to blades **30** interact with one another to center the web on land areas **201** of the support members. Suction is preferably applied to grippers **38** as soon as the web **56** comes in contact therewith, as generally shown in FIG. **4**. This causes each pouch **64** in web **56** to be held precisely

between two blades **30** as the pocket enters the region between guide **26** and roll **22**.

Each pouch **64** in web **56** held by a vacuum gripper **38** is forwarded past guide **26** and into the nip between forwarding roll **22** and mating roll **24**. As is shown in FIGS. **9–14**, the moving web **56** is transversely cut as it passes through the nip at spaced locations along the web, each transverse cut being located at the approximate center of each transverse seal **60**. This is accomplished by the shearing action of cutting corners **34** and **134** of mating blades **30** and **130** on each roll. More specifically, the forward cutting corner **134** of blade **130** slides across cutting corner **34** on blade **30**, causing the sealed lateral portion **60** of the moving web **56** which is situated in between to be sheared. If the web **56** was not previously impaled by pin **36** between guide **26** and roll **22**, or was incompletely impaled prior to entering the nip, the puncturing operation is completed in the nip as the localized web tension is increased by the vacuum gripper **38** in contact with the pouch being severed, the web support member **200** in contact with said pouch, and the shearing blades **30** and **130** effecting the transverse cut, as generally shown in FIGS. **9–14**.

Whether the stress concentration aperture **68** is completed in the nip or between roll **22** and guide **26**, the spatial relationship between the transverse cut and the stress concentration aperture **68** is fixed, since the transverse cut is made in the nip while the web is still engaged on pin **36**. Similaly, if the stress concentration aperture **68** and the transverse cut are made essentially simultaneously in the nip, there is no movement of the web **56** relative to either the cutting or the punching means until both operations have been completed.

As the trailing sealed lateral portion **60** of each pocket **58** in web **56** passes into the nip it is cut by blades **30** and **130**, as described earlier herein, thereby totally separating a finished discrete pouch **64** having a precisely located "easy open" stress concentration aperture **68** in its lateral seal area. Each discrete pouch **64** is secured by suction to forwarding roll **22** until it reaches a point generally underneath the roll where suction is discontinued, as described earlier herein, thereby allowing the pouch to fall into a hopper or continuous motion conveyor (not shown). Again, the length of pin **36** must not be so great as to cause the pouch to hang-up and thereby cause tearing of the lateral seam all the way to the severed edge **70** of the pouch.

The intermittent application of vacuum to the web and pouches described above is accomplished by means of a conventional vacuum commutator **28**, as described earlier herein. Vacuum is applied to grippers **38** upon introduction of web **56** onto roll **22**. Vacuum is maintained in grippers **38** as the gripper openings **44** follow the path of U-shaped slot **48** around to its trailing edge **78**. As each opening **44** passes beyond the trailing edge **78** of the slot **48**, the corresponding gripper **38** is isolated from the vacuum source connected to the commutator until the opening **44** again comes into communication with the leading edge **76** of the slot **48**. Thus, after each opening **44** passes beyond trailing edge **78**, vacuum is released and the finished pouches **64** are released.

If desired, a source of pressurized air can be connected to the commutator **28** downstream of the vacuum slot **48** to expel the finished pouches **64**. In such a system, pressurized air is preferably supplied through a pipe (not shown) which extends through commutator **28** so that its open end exits out of forward face **46** and faces end wall **42** at a point just past trailing edge **78** of slot **48** so as to communicate with openings **44** as they rotate past the open end of the pipe. The pressurized air that exits out of the pipe passes through duct **40** and out the gripper **38** connected thereto, blowing off the finished pouches **64**.

A completed pouch **64** of the present invention, shown in FIG. **15**, contains a stress concentrating aperture **68** precisely spaced from the recently severed lateral edge **70** of the pouch. The aperture is preferably located just below the upper sealed region **72** of the pouch.

The distance between aperture **68** and the adjacent edge **70** is controlled by the size and configuration of pin **36**, the distance "S" between pin **36** and the adjacent cutting corner **34** of blade **30** and the distance between land area **201** of web guide **200** and peripheral surface **32** of blade **30**. The preferred distance between the severed edge of the pouch and the nearest edge of the aperture will, of course, depend on the pouch materials used, the total width of the lateral seals and the size and configuration of the aperture. A distance of about 0.6 mm. has provided reliable manual opening when used with a cylindrical 1.6 mm. diameter, conical tipped pin on laminated plastic pouches having a 6 mm. lateral seam width after cutting, said pouches being made of oriented polypropylene laminated to a saran coated polyethylene and ethylene vinyl acetate copolymer, said laminate structure having an individual wall thickness of about 3.5 mils. The aperture **68** typically created by a conical tipped pin mounted as illustrated herein is irregularly shaped, as generally shown in FIG. **16**. Since no web material is physically removed by pin **36**, a flap **151** of web material is formed, usually at the trailing edge of aperture **68**. For small size apertures, the displaced flap may be of benefit in directing attention to the "easy open" feature by conveying a visual and/or tactile impression to the person seeking to open the pouch. The areas of stress concentration are at corners **154** and **155**. Stress concentrations **154** and **155** reduce the level of applied force required to initiate a tear from aperture **68** to adjacent severed edge **70**. Once a tear is initiated between one of the stress concentrations in aperture **68** and the adjacent pouch edge **70**, it is relatively easy to open the pouch in a direction generally parallel to top seal **72** by separating the pouch segments on opposite sides of the tear from one another. This is believed due to the relatively high shear forces which can easily be exerted as the length of the torn segments increases, since the angle between the segments can more readily be increased to essentially 180°.

If desired, a second "easy open" stress concentration aperture **68** can be provided along severed edge **70** of pouch **64** adjacent pouch edge **74** so that the pouch can be opened from either of two ends. As will be appreciated by those skilled in the art, edge **74** may be a fold in the web material comprising pouch **64**, or a seal area where the pouches are formed by bonding two discrete webs together. Furthermore, two or more pins **36** may be positioned side-by-side across the peripheral surface **32** of each blade **30** on the cutter **20** shown in FIGS. **1** and **4** to produce a line of stress concentration apertures across the width of the sealed lateral portion **60** of pouch **64**. In such circumstance, the height of each succeeding pin may need to be increased as the distance thereof from cutting corner **34** increases. This will ensure web impalement despite the web's increased distance from peripheral surface **32** of blade **30**.

FIG. 17 discloses an alternative stress concentrating aperture **268**. Aperture **268** is preferably formed utilizing a sharpened pin having a triangular shape. The triangular-shaped pin is preferably oriented so that one of its bases forms the leading edge, i.e., the edge closest pocket **58**, of aperture **268**. Three triangular-shaped flaps **251**, **252** and **253** of web material are typically formed about the periphery of the aperture **268**. Areas of stress concentration in aperture **268** are at **254**, **255** and **256**. As with stress concentrations **154** and **155**, stress concentrations **254**, **255** and particularly stress concentration **256** reduce the level of applied force required to initiate a tear from aperture **268** to adjacent severed edge **70**.

FIG. **18** is a schematic representation of a stress concentrating aperture **368** of the present invention. Dividing line "C" in FIG. **18** represents the point of maximum aperture width, as measured in a direction parallel to severed edge **70**. In the event there is more than one point of maximum width within an aperture of the present invention, i.e., a square, dividing line "C" is located as close as possible to pocket **58** of pouch **64**. Although the particular shape of aperture **368** is not critical, it is desirable to avoid inadvertant propagation of a tear into the pocket **58** of pouch **64** during handling. Accordingly, it is generally preferred in the practice of the present invention that those portions of aperture **368** to the left of dividing line "C", i.e., those portions of the aperture, if any, extending into area "A", as shown in FIG. **18**, avoid the inclusion of sharp notches or other localized stress concentrating features. This minimizes the chance of inadvertant tear propagation into pocket **58** prior to manual opening of pouch **64**. Conversely, those portions of aperture **368** on dividing line "C" or within Area "B", as shown in FIG. **18**, preferably include one or more localized stress concentrating features such as sharp corners, notches, slits, small tears and the like. In the embodiment schematically shown in FIG. **18**, point **369** represents such a stress concentrating feature. By so confining the localized stress concentrating feature or features, the applied stress level required to initiate a tear from aperture **368** to severed edge **70** is greatly reduced. Once the tear from the localized stress concentrating feature in aperture **368** reaches severed edge **70**, the pouch segments on opposite sides thereof can be readily separated from one another, since relatively high shear forces can more readily be applied as the length of the torn segments increases.

Although illustrated as a rotary shear cutter, the present invention can also be practiced with a rotary crush cutter, a reciprocating cutter, or other cutting apparatus well known in the art. A rotary crush cutter differs from the embodiment described herein in that the blades on the forwarding roll have sharp edges and mate with an appropriate anvil, which may be a rotating roll or a linearly moving belt. The anvil can have a rigid surface with indentations which conform to the sharp edged blades or it can have a deformable surface. An aperture punching pin can be mounted adjacent each sharp blade, and is preferably radially aligned with and spaced from the blade's sharp cutting edge. If desired, the pin may be cam-actuated to extend just prior to the instant of transverse cutting and punch an aperture in the web as the unsupported sealed portion thereof is being subjected to tension, said pin engaging said web until said transverse cut has been completed. The web **56** may thus be fed continuously between the rotary crush cutter and the anvil without the web undergoing movement relative to either the cutting or the punching means until the cutting and adjacent punching operations have been completed.

Similarly, a reciprocating cutter may be utilized instead of the rotary shear cutter described herein by substituting a rapidly reciprocating blade and an appropriate anvil. The pin which conveniently extends parallel to the blade to the height of the cutting edge of the blade, is mounted adjacent the sharp blade, with its cutting edge spaced from the cutting edge of the blade the distance which it is desired to separate the stress concentrating aperture from the lateral edge of the pouch. The cutter may be cam driven so as to sequentially reciprocate when a predetermined amount of web material has passed by or it may reciprocate in response to sensed information, such as electric eye sensed markings on the pouch. Preferably the web is forwarded intermittently to allow time for the cutter to operate. Alternatively, the entire cutter and punching assembly may be cam driven to follow the web during the pouch cutting and aperture punching operation. In either event, means well known in the art are provided for applying localized tension to the sealed portion of the web during the aperturing operation.

While the precise nature of the cutting or aperturing means is not critical, it is critical to the practice of the present invention that the web undergo no movement relative to the cutting or the punching means until both operations have been completed.

While particular embodiments of the invention have been illustrated and described, it will be obvious to those skilled in the art that various changes and modifications can be made without departing from the spirit and scope of the present invention, and it is intended to cover, in the appended claims, all such changes and modifications.

What is claimed is:

1. A process for forming an easy open stress concentrating aperture in the seal area of a filled and sealed flexible pouch as said pouch is transversely severed from a continuous web of said pouches interconnected to one another along their sealed lateral edges, said stress concentrating aperture being located a predetermined distance from the severed edge of said pouch, said process comprising the steps of:

(a) advancing said web of interconnected pouches to a transverse web cutting means having web aperturing means secured a predetermined distance therefrom;

(b) fixing the position of said sealed lateral edge relative to said cutting and said aperturing means;

(c) subjecting said sealed lateral edge of said pouch to tension as said pouch is being transversely severed from said web along said lateral edge by said cutting means;

(d) contacting said sealed lateral edge and said aperturing means with one another while said sealed lateral edge is in tension and in an unsupported condition to concentrate the stress applied by said tension at said point of contact and thereby rupture said sealed lateral edge a predetermined distance from the severed edge of said pouch; and

(e) removing said pouch from said cutting and said aperturing means after said sealed lateral edge of said pouch has been transversely severed and apertured.

2. The process of claim 1, wherein said tension is applied to said sealed lateral edge of said pouch by said cutting means.

3. The process of claim 2, wherein said sealed lateral edge of said pouch is transversely severed by shearing.

4. The process of claim 1, wherein said sealed lateral edge of said pouch is transversely severed by crush cutting.

5. The process of claim 1, wherein said aperturing of said sealed lateral edge of said pouch is performed by contacting said lateral edge and a pin mounted in fixed relation to said transverse web cutting means with one another.

6. The process of claim 5 wherein said pin and said sealed lateral edge are non-perpendicular to one another when brought together at their point of contact, whereby the shape of said aperture formed in said sealed lateral edge is dissimilar from the cross-sectional shape of said pin.

7. The process of claim 5, wherein said pin and said sealed lateral edge are substantially perpendicular to one another when brought together at their point of contact, whereby the shape of said aperture formed in said sealed lateral edge is substantially the same as the cross-sectional shape of said pin.

8. The process of claim 5, wherein said pin and said transverse web cutting means are operatively connected to one another, whereby said transverse cutting and said aperturing are performed essentially simultaneously.

9. The process of claim 1, wherein said aperturing means is advanced into said web while said transverse cut is being effected and remains engaged in said web until after said transverse cut has been completed.

10. An apparatus for forming an easy open stress concentrating aperture in the seal area of a filled and sealed flexible pouch as said pouch is transversely severed from a continuous web of said pouches interconnected to one another along their sealed lateral edges, said stress concentrating aperture being located a predetermined distance from the severed edge of said pouch, said apparatus comprising:

(a) transverse web cutting means;

(b) means for advancing said web of interconnected pouches to said transverse web cutting means;

(c) aperturing means secured a predetermined distance from said web cutting means;

(d) means for fixing the position of said sealed lateral edge in said web relative to said transverse cutting and said aperturing means;

(e) means for subjecting said sealed lateral edge to tension as said pouch is being transversely severed from said web along said lateral edge by said cutting means;

(f) means for contacting said sealed lateral edge and said aperturing means with one another while said sealed lateral edge is under tension and in an unsupported condition to concentrate the stress applied by said tension at said point of contact and thereby rupture said sealed lateral edge a predetermined distance from the severed edge of said pouch; and

(g) means for removing said pouch from said cutting and said aperturing means after said sealed lateral edge of said pouch has been transversely severed and apertured.

11. The apparatus of claim 10, wherein said transverse web cutting means comprises a pair of mating shearing blades, each of said blades having a cutting corner thereon, and said aperturing means comprises a pin secured in fixed relation to the cutting corner of one of said shearing blades.

12. The apparatus of claim 11, wherein said pin and one of said shearing blades are mounted on the periphery of a first cylindrical drum and the other of said shearing blades is mounted on the periphery of a second cylindrical drum secured to a resiliently mounted shaft and driven in timed relation to said first drum, whereby said blades are caused to contact one another along their cutting corners to shear said sealed lateral edge.

13. The apparatus of claim 11 wherein said pin is oriented so that said pin and said sealed lateral edge are non-perpendicular to one another at their point of contact, whereby said aperture formed in said sealed lateral edge is dissimilar from the cross-sectional shape of said pin.

14. The apparatus of claim 11, wherein said pin is oriented so that said pin and said sealed lateral edge are substantially perpendicular to one another at their point of contact so that the shape of said aperture formed in said sealed lateral edge is substantially the same as the cross-sectional shape of said pin.

15. The apparatus of claim 13 or 14, wherein said pin is cylindrical in cross-section and provided with a conical tip.

16. The apparatus of claim 13 or claim 14, wherein said pin is triangular in cross-section and provided with a tapered triangular tip, said pin being oriented so that one of its bases is substantially parallel to the cutting corner of one of said shearing blades.

17. The apparatus of claim 10, wherein said means for subjecting said sealed lateral edge to tension as said pouch is being transversely severed comprises said cutting means.

18. The apparatus of claim 17, wherein said cutting means comprises a pair of mating shearing blades, each of said blades having a cutting corner thereon, said apparatus also including means for causing said mating blades to contact one another along their cutting corners to shear said sealed lateral edge of said pouch.

19. The apparatus of claim 10, wherein said means for fixing the position of said sealedlateral edge in said web relative to said transverse cutting and said aperturing means comprises a suction cup in fluid communication with a vacuum source, said suction cup being positioned to contact said pouch at a point intermediate its sealed lateral edges.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 4,404,879

DATED : September 20, 1983

INVENTOR(S) : Arthur E. Frohwerk and David E. Enting

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 5, line 21, "clearing" should read -- clearly --.

Column 7, line 25, "Accordingly,," should read -- Accordingly, --.

Column 9, line 29, "Similaly" should read -- Similarly --.

Column 11, line 32, "inadvertant" should read -- inadvertent --.

Column 11, line 24, "inadvertant" should read -- inadvertent --.

Column 14, line 33, after "claim 13 or" insert -- claim --.

Column 14, line 52, "sealedlateral" should read -- sealed lateral --.

Signed and Sealed this

Twenty-ninth Day of *November 1983*

[SEAL]

Attest:

GERALD J. MOSSINGHOFF

Attesting Officer

Commissioner of Patents and Trademarks